



**PHYSICAL MECHANISMS CONTROLLING UPPER TROPOSPHERIC  
WATER VAPOR AS REVEALED BY MLS DATA FROM UARS**

**THIRD YEAR PROGRESS REPORT AND FINAL REPORT**

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## Introduction

The Microwave Limb Sounder (MLS) on the Upper Atmosphere Research Satellite (UARS) was found to be sensitive to the thermal emission from water vapor (Read et al. 1995; Read et al., 2001). These two references provide an excellent background for this application. Given additional material, such as the papers by Tuck et al. (1997) and Holton et al. (1995), one can search back in the literature for past views on the physical processes governing the atmospheric distribution of water vapor in the upper troposphere and lower stratosphere. To make the search current there is the "SPARC Assessment of Upper Tropospheric and Stratospheric Water Vapour - December 2000" (Kley, Russell, III and Phillips, 2001).

## Comments on Work

Upper Tropospheric Humidity (UTH) may be used to represent the water vapor in the upper troposphere. Our early paper on the positive relation between higher UTH at 215 hPa and enhanced convection (Newell et al., 1997) suggests there is a possible cause and effect present. One can make a similar argument for the large-scale association between high pressure convergent regions at 215 hPa and amplified sinking motions (cf. Newell et al., 1996).

The next step was to submit a paper "Factors Controlling Upper-Troposphere Water Vapor" by Zhu and Newell at MIT and W.G. Read at JPL to the Journal of Climate in September 1998; this appeared in February 2000 (Journal of Climate, 13, 836-848). Several changes followed a standard break-up of the terms into eddy motions and mean motions of the type used by Peixoto, J.P. and A.H. Oort (1992), but as modified by Zhu and Newell (1998). A second paper including the transport processes together with

European Center for Medium-Range Weather Forecasts wind data has also been submitted to the Journal of Climate (Water Vapor Distribution and Transport in the Region 464-10 hPa from UARS MLS Data by Newell, Zhu, Reid and Pumphrey) and is presently now being revised; H. Pumphrey has been our collaborator at the University of Edinburgh, Scotland. An interesting point is that the residence time for water vapor above the tropical tropopause is about 3 years. The error bars on the covariances are presently being reconsidered. The paper has evoked some interesting response. A copy of the first paper is attached to this report.

Another topic being recognized as a possible point of interest was the study of along-aircraft-track data by Fourier analysis. This was discussed in the JPL Pasadena meeting but on return it was decided in discussions here that the topic was not profitable. A final topic being considered was to examine the radiation from different parts of the infrared spectrum and to study the radiation changes in different parts of the spectrum. Part of this work was carried out with a group at Langley using new observations. Following this work it became clear in a poster session that there was some additional work to be done. That remains for the future.

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